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PALMS:

Partnerships Advancing the Learning of
Mathematics and Science

Mid Point Progress Report



January 1995

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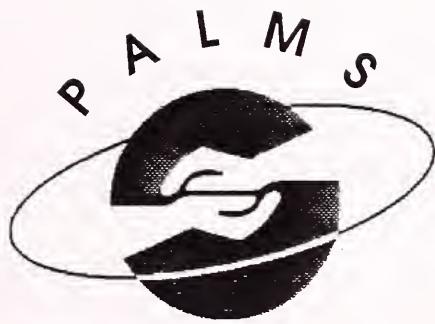
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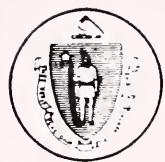


Mid Point Report

Partnerships Advancing the Learning of
Mathematics and Science



A Cooperative Statewide Systemic Initiative of the
Massachusetts Department of Education
and the National Science Foundation



The Commonwealth of Massachusetts Department of Education

350 Main Street, Malden, Massachusetts 02148-5023

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Robert V. Antonucci
Commissioner

February 1, 1995

Dear Colleagues and Community Members:

One of the real success stories of Education Reform in the Commonwealth to date is the PALMS initiative. PALMS, Partnerships Advancing the Learning of Mathematics and Science, is a cooperative effort between the Massachusetts Department of Education and the National Science Foundation to systemically improve the learning and teaching of mathematics and science. Now in its third year, PALMS has already engaged 62 school districts in this process.

As the Mid-Point Report illustrates, PALMS reinforces and extends the work being done through our own Education Reform Act especially in the areas of curriculum and professional development. Through PALMS, the first of the curriculum frameworks drafts called for in Chapter 71 have been developed in the areas of math and science & technology. Additionally, PALMS has created a core group of skillful change agents among educators at all levels across the Commonwealth, providing a powerful model for constructive change in math and science and other subject areas. This report also details the PALMS management structure, key accomplishments, and challenges related to each focal area of the initiative.

Over the next two and a half years, PALMS will continue to scale-up its efforts to reach new districts in conjunction with the efforts of the Education Reform Act and Goals 2000. We approach the second half of the PALMS initiative with confidence and excitement. We look forward to your continued support.

Sincerely,

A handwritten signature in black ink that reads "Robert V. Antonucci".

Robert V. Antonucci
Commissioner of Education

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I. Introduction and Context

Massachusetts, the birthplace of public education in the United States, has a strong tradition of local control, wide disparities in per-pupil spending between rich and poor districts, and a wealth of technical and intellectual resources in its industries, universities and cultural institutions. Characteristics of the public education system statewide include:

- 331 districts - largest district has 64,000 students
- 66,000 teachers and administrators
- 1800 schools for 860,000 public school students K-12
- 8% of students are African-American, 8.5% Hispanic, 3.6% Asian, 79.8% Caucasian
- 14% low-income and AFDC; 12% first language not English; 17% special ed
- 21,000 adult students enrolled in Adult Basic Education in 1992
- 4-year drop-out rate 15%

Pressure to change and improve public education has been intense in Massachusetts since the late 1980's, but until the last few years the state government's unwillingness or inability to provide substantial funding led to discrete program initiatives that were not sustained and made little difference. Momentum for a comprehensive approach to school improvement which was to include substantial monies and increased accountability began to gather in the early 1990's, led by a coalition of business leaders, the Massachusetts Business Alliance for Education. During the period of debate on education reform, the Department of Education made a proposal to the National Science Foundation which represented the state's first real effort at a systemic and comprehensive approach to improving student learning. PALMS, Partnerships Advancing Learning in Mathematics and Science, began in September 1992 with \$10 million of NSF funding, matching state funds, and substantial support from a private foundation and from industry.

The initiation of PALMS was followed in June 1993 by passage into law of the Massachusetts Education Reform Act, which calls for extensive change in the governance and financing of schools, stronger guidance from the Department of Education in regard to educational goals and curriculum frameworks, more extensive and coherent professional development for teachers and administrators, and changes in the statewide assessment program. PALMS has matured in the midst of this environment of substantial statewide change.

II. PALMS and Education Reform

In order to understand fully the potential impact of PALMS, it is necessary to describe briefly the scope of Massachusetts's sweeping Education Reform Act and how it is congruent with PALMS. The law includes more than one hundred separate initiatives, which can be organized into five strategic goals:

1. **Establish new standards and programs for students that ensure high achievement.** This goal calls for the creation of a Common Core of Learning, followed by the development of Curriculum Frameworks in major subject areas and an assessment program directly linked to the Frameworks. PALMS led the way by creating the first Curriculum Frameworks in Mathematics and in Science & Technology.
2. **Administer a fair and equitable system of school finance.** The Reform Act's approach to equity focuses primarily on school finance. The foundation formula, aimed at ameliorating the wide discrepancies in per-pupil spending in different school districts, calls for all students to be at a foundation funding level of approximately \$5500 per pupil at the end of seven years, through a mix of local and state funds. Over \$1 billion of state funds are to be distributed to school districts over the next seven years to support this goal.

The original PALMS districts were chosen to represent the diversity of school districts in Massachusetts. Since equity is central to PALMS, the initiative has consistently directed more resources to needier districts with high proportions of economically disadvantaged students. In addition, the PALMS Curriculum Frameworks support the Reform Act's elimination of the general track and take a strong stand against academic tracking.

3. **Work with school districts to create a governance structure that encourages innovation and accountability.** A major new structure called for in the law is the school council, a body composed of parent, teacher and community representatives and charged with developing a school improvement plan. The PALMS approach complements this model by providing for a district-level Leadersgip Team for Systemic Change composed of teachers, parents, administrators, and outside partners from business, cultural institutions, adult education and higher education. This team is charged with supporting partnerships and creating an action plan for the systemic improvement of science and mathematics education district-wide.
4. **Enhance the quality and accountability of all educational personnel.** For the first time, Massachusetts educators will need to be recertified every five years. New performance standards for teachers and administrators are being established, and all educators will need to develop and fulfill professional development plans. Members of PALMS staff have been a part of all decision groups working on the State Professional Development Plan, and the PALMS design for delivering professional development and certifying achievement is looked upon as a model.
5. **Improve the Department of Education's capacity and effectiveness in implementing Education Reform.** The Department has reorganized into overlapping service clusters that focus on service rather than bureaucracy. PALMS benefits from this structure by receiving major in-kind support from the Department in the form of personnel. At the same time, PALMS exemplifies the service orientation of the Department and has led the way in providing a technology infrastructure that supports the Department objective of using electronic communications to improve outreach and responsiveness to districts.

III. Background Information on the SSI

PALMS was designed to capitalize on the rich technical and intellectual resources of Massachusetts by developing a model of change built on partnerships and professional development. Because of the strong Massachusetts tradition of local control, the chosen unit of change was the school district, where a multisector leadership change team would create a district action plan to examine and improve teaching and learning in mathematics and science. PALMS provided training and technical assistance to all the Leadership Teams. A pivotal role on the Leadership Team was assumed by one or more PALMS Specialists, teacher-leaders released on sabbatical and provided with 3 months of training and nine months of practice in constructivist learning, exemplary curricular materials, new ways of teaching, and the change process. In order to catalyze systemic change, each team also included administrators, curriculum specialists, other teachers, and members from the business community, higher education, a museum, and an adult education center.

Initial emphasis was on grades K-8, although adult education centers were included from the start. Thirteen original PALMS districts were chosen to represent economic, ethnic, and language diversity and to include a mix of urban, rural, and suburban districts, while targeting districts with a high proportion of underrepresented and disadvantaged students.

Initial PALMS goals, along with the focal areas and goals as they currently guide the initiative, are shown in Appendix 1. PALMS focal areas and goals have evolved as a result of accomplishments, feedback from our evaluators and NSF, and new opportunities that have arisen. For example, success in creating Curriculum Frameworks that outline important content and define "quality mathematics and science" has allowed

PALMS to focus more attention on identifying and implementing high quality curricula in the classroom. Although equity has been a concern of PALMS from the start, feedback from NSF has underlined the necessity of formulating a comprehensive and specific strategy to address equity at all levels of the initiative. Documentation and formative evaluation are infused throughout the project and no longer considered as a separate area. We expect this process of evolution to continue.

Priorities in the first two years were creating Curriculum Frameworks, developing a cadre of committed change agents, and testing the PALMS model of district change. By design, the first two years of the project concentrated on honing this model in the initial demonstration districts and expanding the model to a limited number of surrounding districts. Early dissemination strategies focused on professional development. The original **PALMS Specialists**, assisted by Department of Education staff and TERC* consultants, helped disseminate by running two-week Summer Institutes for teams of teachers and administrators from new districts. After the summer institutes the new districts were given further professional development, a pathway by which committed teachers could become certified **PALMS Trainers****, technical assistance for forming and using a Leadership Team, and small grants to facilitate change. By this means the number of districts fully implementing the model grew from twelve in the first year to thirty-one at the start of the third year, with another thirty-one districts in the planning and preparation stage. Nevertheless, the rate of growth provided by this model is limited. In order to provide wider access to PALMS and to improve the sustainability of the initiative, our current priority is to scale up through the vehicle of a diverse group of Regional Providers that will ultimately have the capacity to reach all Massachusetts districts.

IV. Governance and management structure

PALMS is housed within the Massachusetts Department of Education, which serves as the fiscal agent and contributes substantial funds and personnel to the initiative. The original leadership included an Associate Commissioner of Education, who served as primary Principal Investigator, and two co-PIs outside the Department, each of whom contributed 20% time. In addition, PALMS had a full-time Project Director within the Department and an advisory steering group, known as PRISM,*** composed of approximately 110 stakeholders from the education and business communities. Although PRISM's Executive Committee and two subcommittees met regularly and provided input into the PALMS design, the size of PRISM itself made the larger body unwieldy and impractical. In addition, during the first year of PALMS, the Department reorganized and moved, and the passage of the Education Reform Act of 1993 consumed a great deal of Department energy and attention.

A. Mid-Course Correction and Renewal

In early 1994, faced with these changes in the state education landscape, the reassignment of the original Project Director, and the imminent departure of the primary Principal Investigator to take a position in another state, the leadership of PALMS, in consultation with the Commissioner and NSF, moved to reorganize the initiative. The Deputy Commissioner of Education took on the role of co-PI to lead the task of coordinating PALMS with other aspects of Education Reform. The PRISM Executive Committee was reorganized into the PALMS Steering Committee, and the Commissioner clarified and formalized its role. A search for a new Project Director was launched.

Currently PALMS is led by a team of four equally active co-Principal Investigators, including two engineering professors (the original co-PIs), the Deputy Commissioner, and a trustee of a private foundation. Day to day leadership is provided by a Project Director who holds the rank of Associate Commissioner at the Department of Education and combines a background in mathematics and science

* Technical Education Research Center of Cambridge, MA, is an internationally recognized consultant in the area of science education.

** PALMS specialists and trainers will be further described in the section on Professional Development.

*** Policy Representatives for the Integration of Science and Mathematics.

teaching with management experience in a large high-tech company. Cohesion and communication within the PALMS leadership, between leadership and staff, and between PALMS and other clusters within the Department of Education are stronger than at any time since the initiative was launched. The Steering Committee, which represents the major stakeholders in Massachusetts education reform, including business, parents, teacher and administrator professional groups, higher education, museum partners, and representatives from the governor's office and legislature, is formally charged by the Commissioner with the responsibility of advising the PI's, raising issues as necessary, communicating the agenda of reform to the constituencies it represents, and briefing the Commissioner yearly on the progress of the mathematics and science reform effort.

V. Accomplishments and challenges

A. Curriculum Frameworks and Quality Mathematics & Science

Major Accomplishment: PALMS created the first Massachusetts Curriculum Frameworks in Mathematics and Science & Technology. In 1992 Massachusetts lacked official guiding documents from the state on matters of curriculum and content. For example, the only statewide requirement for high school graduation was four years of physical education and one year of American history. In its cooperative agreement with NSF, PALMS committed to creating the first curriculum frameworks for mathematics and science. A year later, the Education Reform Act called for the creation of frameworks in other subject areas.

Two PALMS Curriculum Frameworks writing groups that included teachers, administrators, scientists, mathematicians, college faculty, parents, and representatives of businesses and community organizations across the state met monthly over the course of a year to develop Curriculum Frameworks. The science and mathematics groups worked in concert to create common chapters and separately on content area chapters. Four regional forums held around the state garnered public input. The draft Frameworks were then aligned with the emerging Common Core of Learning and released, in October 1994, for public comment and review. The Mathematics and Science & Technology Curriculum Frameworks have been independently reviewed by both the Council of Chief State School Officers and an out-of-state peer review panel.*

Curriculum Frameworks in other subject areas are now being developed through a process that closely matches that modeled by PALMS, and all the Frameworks will be presented to the Board of Education for approval by June 1995. The state has already set aside \$2.225 million in 1994-95 for non-competitive grants to school districts and vocational-technical schools to form study groups and plan implementation of Frameworks in the different subject areas. It is our expectation that many districts will focus their efforts on mathematics and science in this first year.

As the Frameworks were being developed, PALMS turned its attention to providing information about and access to exemplary curricula and teacher enhancement opportunities that would support their implementation. PALMS created a directory of NSF-funded projects in Massachusetts, cross-referenced by region and subject area. One of the PALMS PI's established the Statewide Implementation Program (SIP), a 5-year, \$4.4 million NSF-funded project that will showcase exemplary multi-year curricula and support districts in their implementation. In the first year, SIP supported eight districts in implementing five such curricula, including Science and Technology for Children, the Interactive Mathematics Program, GrowLab, Used Numbers, and Image Processing for Teaching. Six new exemplary curricula have been showcased in 1994. One outgrowth of SIP's first year, spearheaded by two of the PALMS PIs, was the establishment at

* A letter from Rolf K. Blank, Director of CESSO Science-Math Frameworks Study, dated October 25, 1994, summarized the review as follows: "The Massachusetts Frameworks were identified as good examples of framework development in the areas of 'rationale or vision,' 'internal consistency,' 'use of vignettes and examples,' strategies for implementing 'equity in the curriculum,' and clarity of language and presentation of content."

The Report of the Curriculum Frameworks Peer Review Panel, prepared by Celeste Pea and Claudia Townsend from the Louisiana Systemic Initiatives Program, cited as additional strengths the Frameworks' alignment with national standards, incorporation of adult education, and connection to vocational education.

Northeastern University of the New England Regional Center for Interactive Mathematics. This independent center will promote the wider implementation of a challenging, integrated, and untracked college preparatory mathematics sequence. Most recently, SIP and PALMS together have established a Task Force on Quality Mathematics and Science to research and provide information on a wide variety of strong curricula that can support Framework implementation.

Challenges: A major challenge for the state will be to implement new assessment practices which will be piloted next year and launched widely in 1996-97. The Education Reform Act requires the development of authentic assessment instruments, which are likely to start with an on-demand test and ultimately lead to the use of portfolios. Assessment standards will be based directly on the Curriculum Frameworks. PALMS staff are working closely with the Assessment cluster in the Department both on the development of statewide assessments at grades 4, 8 and 10 and on alternative classroom assessments such as the New Standards Project. PALMS personnel have been invited to serve on the Statewide Assessment Advisory Committee, and PALMS districts will be among those in which the new assessments will be piloted.

A second challenge is to ensure that the Frameworks are used to guide district curriculum and professional development planning. State grants for Frameworks study, publications targeted to specific groups such as teachers, parents, and administrators, workshops led by Regional Providers, and information on exemplary curricula disseminated by the Task Force on Quality Mathematics and Science will all contribute to ensuring that the Frameworks are implemented.

B. Professional Development

Major Accomplishment: PALMS constructed a self-sustaining model of professional development for teacher leaders that has led to the creation of a cadre of committed change agents. The PALMS strategy for professional development has been to provide a transforming experience for a core group of educators, allowing them to become leaders who spearhead change within their own classrooms, schools, and districts. At the same time, these core leaders guide increasing numbers of their colleagues through the same sustained and reflective change process that they have undergone. The first cadre of teachers trained by PALMS, now known as the PALMS Specialists, were recruited from the first PALMS districts and given a sabbatical leave for the full 1992-93 school year. These 25 teachers joined museum educators, university educators, and PALMS staff for a three-month training institute in the fall of 1992. During this institute, led by TERC staff, the PALMS Specialists immersed themselves in hands-on, inquiry-based mathematics and science; in research on school change and student learning; and in study of state, national, and international curriculum frameworks. They enunciated the PALMS Principles,* which define what PALMS means by quality mathematics and science teaching and learning. These principles continue to serve as a concise expression of the PALMS philosophy of learning. As such they have guided all activities related to professional development and creation of Curriculum Frameworks.

After the institute, teachers returned to their districts to change their own classrooms, provide workshops and coach their colleagues, lead Family Math and Science nights, and assume a pivotal role on their district leadership change teams. Six months later, the Specialists led the first PALMS Summer Mathematics and Science Institutes. The Summer Institutes were held in five regions of the state for teacher-administrators teams that wanted to try the PALMS approach to teaching, learning, and district change. PALMS Summer Institutes introduced participants to the PALMS philosophy, plunged them into their own inquiry-based cooperative learning experiences, and led them through workshops on equity and change.

Of the 120 teachers who attended the first PALMS Summer Institutes in 1993, fifty-two registered to continue their professional development by becoming PALMS Trainers. In order to become PALMS Trainers, teachers are mentored by PALMS Specialists, receive over 200 hours of professional development, and create a professional portfolio that exhibits their practice and leadership. They design a personal professional development plan, provide workshops and coaching for other teachers, participate on their

* See Appendix 2

own district leadership change team, share information about PALMS and Education Reform with the broader school community, and assist with planning and delivery of future PALMS Summer Institutes. Twenty-five teachers have completed these requirements and are now certified as PALMS Trainers. Another 27 are in their second year of preparation, and of the 329 teachers, administrators and partners who joined the 1994 summer institutes, 150 or more are expected eventually to become trainers themselves.

The original PALMS Specialists continue to play a key role in their own districts and statewide. Several have extended their role to include neighboring districts; some co-teach university pre-service or inservice courses; some act as consultants to museums. PALMS Trainers, on the other hand, are classroom-based and model change or provide workshops primarily within a single school or district.

Programs partnering with PALMS have also provided professional development in inquiry-based mathematics and science content and pedagogy to Massachusetts teachers. The Museum Institute for Teaching Science, a PALMS partner, has organized Massachusetts museums to provide over 400 teachers with two-week programs on the themes of Our Watery World and Biodiversity, emphasizing the PALMS approach. Over 110 teachers have taken one-week mini-sabbaticals doing research at the Boston Museum of Science. Two PALMS districts sent teams to a four-week MIT institute focused on investigations (first by teachers and later by students) of the technology-society interface, using such concrete community-based examples as public transportation systems, water systems and communication systems. The Buzzard's Bay Rim Project, a three-year project funded by NSF, uses a lead teacher model to provide content knowledge, pedagogical skills and leadership skills to teachers in eight school districts, including two PALMS Sites. Over the three years of the project a cadre of 90 lead teachers will become part of a regional team for systemic change. All of these professional development programs build on the PALMS model of partnerships, leadership, and inquiry. Altogether, PALMS professional development activities have engaged over 12,000 teachers and administrators in the past two and a half years.

District and statewide interest in the professional development experiences offered by PALMS has grown in the past year because of Education Reform's new requirement that teachers be recertified every five years. Recertification requires that teachers accumulate at least 120 professional development points in their area of certification. Members of the PALMS staff assisted in writing the regulations, which emphasize sustained, reflective experiences, and which encourage teachers to include mentoring, peer coaching, and action research in their professional development plans.

Challenges: Major challenges during the next few years will be to strengthen the mathematics and science content base of PALMS professional development, to integrate professional development with the regional scale-up strategy discussed below, and to increase the diversity represented by PALMS Specialists and Trainers. In order to do the first, we are working to couple PALMS Summer Institutes with other high-quality summer teacher enhancement experiences offered in Massachusetts. To address the second, we are arranging to locate many of the PALMS professional development activities at the Regional Provider sites. The third will be a focus of the newly created Equity Task Force. Our current plan is to offer preference for placement in Summer institutes to district teams that include teachers who are members of underrepresented groups.

C. Teacher Preparation and College Partnerships

Major Accomplishment: PALMS has engaged 32 colleges in partnerships with districts and in self-examination leading to changes in mathematics and science instruction for undergraduates, pre-service teachers, and inservice educators. This number represents 70% of those colleges in Massachusetts that prepare teachers. Colleges are involved to different degrees and in different ways. Some have been funded directly by PALMS and some have used Higher Education Eisenhower grants to further their change agenda. In most cases change began in one or two college classrooms and has extended to discussions within departments or in a college-wide leadership change team. Changes that are underway in some colleges include establishing interdisciplinary majors that emphasize mathematics and science, using a constructivist approach in mathematics and science methods courses, and putting in place modules that ensure that preservice and inservice educators learn mathematics and science content through integrated

project-based exploration. Many colleges, including Springfield College, Fitchburg State College, Wheaton College, and others use PALMS Specialists as co-teachers for preservice or inservice courses. Many colleges, including Bridgewater State College, Wheelock College, Mount Holyoke, Clark University, and others, place student teachers in innovative classrooms in PALMS classrooms in PALMS districts.

Challenges include ensuring that state policies for certification and program accreditation support the PALMS goals, involving more colleges more deeply in PALMS, and improving the articulation between K-12 and higher education, especially in the area of college admissions policy. PALMS has begun to facilitate conversations among admissions officers of Massachusetts research universities and the University of Massachusetts system about piloting admissions procedures based on authentic assessments and portfolios rather than standardized test scores.

D. Change at the District Level

Major Accomplishment: PALMS has developed a model for change at the district level led by a multisector leadership change team, and has demonstrated its effectiveness in 27 districts. Data from our evaluators indicate that the PALMS leadership change team provided a focus for reform and for effective partnerships with businesses and museums in those districts that were ready for change. In Year One, thirteen districts established leadership change teams; by the start of Year Three, 32 districts, serving 26% of Massachusetts public schoolchildren, had active leadership change teams working to improve mathematics and science education. In addition, teams from another thirty districts were introduced to the model through the Summer Mathematics and Science Institutes. Of the 27 districts for which we have data as of Year Two,

- 26 have active museum partners
- 26 have active higher education partners
- 20 have active business partners
- 12 have active adult education partners
- at least 21 have leadership change teams that meet regularly
- all have district action plans that address the PALMS goals
- 25 have parents active in community outreach and training

Many of the partnerships have had a powerful impact. For example, the Foxboro Company provided a Total Quality Management perspective to the Foxboro and Lunenberg Leadership Teams, and collaborated with Bridgewater State College to establish a network of 50 local businesses to work with classroom teachers in bringing hands-on, real-world applications to the classroom.

E. Adult Basic Education

Major Accomplishment: PALMS improved the learning and teaching of mathematics and science for our state's undereducated adults, targeting the 21,000 adults enrolled in 150 adult learning centers. From the beginning, PALMS demonstration sites included adult learning centers. In Year One, the six PALMS adult learning center teachers joined with 14 other ABE teachers (the ABE Mathematics Team) to rethink and reform mathematics instruction in their own classes. The team wrote a set of NCTM-based standards for adults, piloted the standards with over 200 adult learners, and documented the results of their classroom research. The standards and research have been incorporated into the Massachusetts Curriculum Frameworks, and have been disseminated to all adult learning centers in Massachusetts and to every state's Adult Basic Education director. By the end of Year Three, 200 ABE teachers representing almost all of the 150 adult learning centers in Massachusetts will have attended a day-long workshop on the standards, and 30-60 of these teachers will form six-month study circles to pilot and record classroom strategies. The missionary zeal of this group to energize their teaching has spread to several other states, and has seeded a national movement on Adult Mathematical Literacy.

In twelve of the current PALMS districts, adult learning centers have actively engaged with the leadership change teams. Of particular note is the success of Family Math and Science nights which have taken place at the adult learning centers, engaging 400 adults and their children.

Challenges: While standards and curricula for mathematical literacy (numeracy) have been developed, little attention has been paid to science literacy. Several PALMS ABE teachers have expressed an interest in reforming science education and could provide leadership similar to the mathematics team.

While several Family Math and Science nights have caught the attention and interest of parents who are urban, poor, under-educated or language-minority, we would like to find ways for these parents to take leadership roles in mathematics and science reform. Our current plan is to spark such leadership by training parents to lead Family Math nights.

F. Scale-up Strategy

Major Accomplishment: PALMS has developed and begun to implement a strategy that will ultimately allow reform in mathematics and science education to reach every district in Massachusetts. By the second year of PALMS, 27 of the state's 331 districts were implementing the PALMS model. The model of partnerships, district leadership change teams, and teacher leaders was effective, and more districts wanted to become part of PALMS than could be accommodated under the existing structure of financial and staff support. With input from the Steering Committee, the PALMS leadership developed a regional scale-up strategy. In the spring of 1993, PALMS issued a competitive RFP for Regional Providers to expand participation in PALMS to a larger number of districts.

In 1994, five Regional Providers were identified and granted up to \$110,000 each to reach out to new districts while continuing contact and support for existing PALMS districts. In addition, Attleboro has established itself as a lighthouse district providing mentoring to ten neighboring districts. The Regional Providers are a diverse group, including colleges and universities, educational collaboratives, and a museum. They represent a wealth of expertise in mathematics, science, and technology, and a wealth of experience in providing professional development experiences to teachers and administrators. Together, these providers have the capacity to coach at least 120 new districts in the PALMS model for change. Since all are existing non-profit entities with their own funding streams, strengthening the Regional Providers means building an infrastructure that can sustain the PALMS effort beyond the period of NSF funding.

Challenges: This is the first year of experience with the regional model. Our primary challenge will be to maintain the quality of PALMS as the initiative spreads and becomes increasingly decentralized. The Regional Providers have a clear deliverable: the number of districts in their service area who form working leadership change teams and develop and implement comprehensive action plans to improve student learning of science and mathematics. To provide technical assistance to the Regional Providers we have created a Regional Service Team of PALMS staff with expertise in science, mathematics, technology, assessment, and the change process. The Regional Providers meet together regularly as a group to share tactics and concerns. We are developing a district self-assessment tool which the Regional Providers can use with districts to guide them through the process of improving mathematics and science learning.

A second challenge will be to increase the reach of the initiative, either by increasing the number of Regional Providers or by extending the reach of those already involved. The PALMS Task Force on Business Partnerships is currently working with the Mass Jobs Council on a strategy to link the Regional Providers to the sixteen Regional Employment Boards to coordinate implementation of a \$25.4 million School to Work program.

G. Equity and Student Achievement

Major Accomplishment: From its inception, PALMS has targeted districts with high numbers of underserved students. After two years, students in PALMS districts are showing performance gains that begin to close the gap between PALMS and non-PALMS districts. The PALMS commitment to equity is reflected in the vision's emphasis on all students, the initial choice of districts, and the focus on instructional strategies, including hands-on learning and cooperative learning, that have been shown to improve the performance of students from underrepresented groups. Equity concerns guided the Curriculum Frameworks writing groups, which, according to the report of the out-of-state peer review panel, created documents that "contained a very strong equity component and aggressively address[ed] the issue of

tracking." The stance against tracking is further supported by the Education Reform Act of 1993, which requires that the high school general track be abolished by 1995.

The initial PALMS sites were chosen to reflect the demographic diversity of the Commonwealth. Six districts, including four urban districts with high percentages of economically disadvantaged students and students from underrepresented groups, were fully funded by the grant. An additional seven districts were partially funded by the Noyce Foundation, but were required to put up matching funds of their own. Thus, the number and diversity of districts was increased, while the bulk of resources went to the poorer districts.

- Current PALMS districts enroll 26% of all Massachusetts public schoolchildren, including 17% of all the Caucasian students, 35% of the Asian students, 55% of the Hispanic students, and 69% of the African-American students.
- Current PALMS districts enroll 57% of the Massachusetts students who have limited English proficiency
- 82% of PALMS students are from districts where the per-capita income falls below the statewide median; PALMS districts serve 44% of the low-income students in the state.

Preliminary data about the effect that PALMS has had in the first cohort of twelve districts comes from comparing 1992 and 1994 results of the statewide assessments given at Grades 4, 8, and 10. Because the initial focus of PALMS was on the elementary grades, we examined grade 4 data. Scaled scores are displayed in the table below.* The data shows that fourth-grade students in PALMS districts had a lower baseline achievement level in both mathematics and science in 1992 than did fourth-graders in non-PALMS districts. But between 1992 and 1994, after only 18 months of PALMS activities in the districts, fourth-graders in PALMS districts other than Boston improved more in both mathematics and science scores than did their peers in non-PALMS districts. And in Boston, where PALMS has penetrated only about one third of the schools to date, PALMS schools showed greater improvement in fourth-grade scores than did non-PALMS schools in Boston (and greater improvement than non-PALMS districts elsewhere in the state). In both cases, the PALMS schools and districts started with lower than average student achievement, and two years later were showing signs of catching up. Similar trends exist in the student proficiency data shown in Appendix 3. More students in PALMS districts and schools than students from non-PALMS districts and schools moved up from a proficiency level of 1 or less to a proficiency level of 2 or more.

PALMS Districts other than Boston	1992	1994	Change
Science	1293	1305	+12
Math	1287	1324	+37
Non-PALMS Districts			
Science	1348	1346	-2
Math	1343	1364	+21
All Boston			
Science	1168	1165	-3
Math	1151	1163	+12
Boston PALMS Schools			
Science	1118	1134	+16
Math	1111	1128	+27
Boston Non-PALMS Schools			
Science	1173	1169	-4
Math	1156	1167	+11

* Scaled scores compare schools to one another and range from 1100 to 1600; mean statewide score in 1988 was 1300 in every subject.

Equity has been addressed in all PALMS Summer Institutes, and equity concerns are addressed in all PALMS RFP's. Nevertheless, feedback from our evaluators on the Summer Institutes and the involvement of parents has indicated that PALMS needs to pay more concerted and specific attention to equity. Thus equity has become a new focal area, and the PALMS equity goal is emphasized in PALMS orientation and outreach activities. Diversity on the Steering Committee and staff has increased. Two equity specialists have joined the PALMS staff team, all staff have participated in Efficacy Training, and strategies to achieve the benchmarks set out in the NSF Equity Frameworks permeate the PALMS strategic plan.

Challenges include establishing baseline data to allow us to measure progress. Current state data does not disaggregate student achievement by ethnicity, nor does it provide information about the ethnicity of teachers. Our approach to disaggregating student progress data will be to urge districts to examine their own student achievement data and specifically address how to close performance gaps as part of their district action plans.

A second challenge is to identify and disseminate examples of effective classroom strategies for engaging diverse learners. As one example, PALMS is currently working with Clark University on a proposal to establish a dissemination center for the Complex Instruction Project in the central part of the state.

H. Community Outreach

Major Accomplishment: PALMS has developed a multi-tiered approach to community outreach, facilitating local public relations efforts and integrating the PALMS message and approach with the state's agenda and strategy for promoting Education Reform. In the first year, PALMS collaborated with MIT, the Museum of Science, and a local CBS affiliate to produce an hour-long television program emphasizing the importance of science and mathematics education and its relevance to workplace skills. Another program by an ABC affiliate has showcased the work of PALMS Specialists.

At the regional level, PALMS has held regional parent showcases reaching over 2500 parents. To assist local efforts, PALMS has incorporated public relations training in the leadership strand of its professional development activities, and has provided ongoing technical assistance to local leaders. Coverage of PALMS in local papers has been extensive and favorable. PALMS maintains contact with all its constituents via a Partners newsletter, and extends its reach by posting both the newsletter and special bulletins on the Internet.

In the past year, PALMS has worked to align its communications with other Department public relations efforts, so that in format, content and approach, PALMS and Education Reform publications clearly represent two facets of a unified effort.

Challenges to be met as PALMS scales up its efforts include assisting the Regional Providers in their community outreach, particularly by building on partnerships that PALMS has begun to form with representatives of the public relations and advertising industry.

I. Technology as an Educational Tool

Major Accomplishment: PALMS has provided a server to connect all schools and districts to the Department of Education, and has demonstrated that educators trained in telecommunications will use the network to share projects, strategies, and information. PALMS has led the way in technology for the state by purchasing Internet accounts for all PALMS teachers and partners, training them in telecommunications, and using the network as a tool for communicating PALMS information. Over 200 partners use their accounts regularly to exchange ideas and information. PALMS has provided the server which by the end of this year will connect all schools and districts in the state to the Department of Education. The Curriculum Frameworks will be among the documents made available electronically via the network. Future plans include a tie-in for all teachers, development of local technology plans in all districts, and legislative approval of a \$50 million bond issue for a statewide technology infrastructure. PALMS will be an integral part of all these efforts.

VI. Alignment with state policies and other initiatives

PALMS has received financial support from four primary sources: the National Science Foundation, the Massachusetts Department of Education, the U.S. Department of Education, and the Noyce Foundation. The state DOE has matched the NSF contribution with \$6 million to date, and commits to continuing a dollar-for-dollar match, subject to legislative appropriation. In addition to funds, the DOE provides in-kind contribution of staff time. In Year 3, the equivalent value of this staffing, including fringe benefits and overhead costs, is estimated to be \$450,000. The U.S. DOE, through the Eisenhower program, has granted PALMS \$1.3 million for development and implementation of Curriculum Frameworks in grades 9-12, to be expended in Years 2, 3, and 4 of the initiative. In its first three years, PALMS has received \$900,000 from the Noyce Foundation, with 90% of this money going directly to school districts or Regional Providers. In addition, approximately \$500,000 of other Noyce Foundation grants for Massachusetts science and mathematics has been directed to projects or school change initiatives which are explicitly linked to PALMS.

Related funding includes \$100,000 received from the National Institute for Literacy for the development of the Adult Basic Education Mathematics Standards, and approximately \$1.2 million of higher education Eisenhower funding awarded annually to colleges and universities by the Higher Education Coordinating Council. The council sets aside a portion of these funds to support institutions involved as partners in PALMS demonstration sites, and ensures that all grants reflect PALMS philosophy and principles.

PALMS activities are aligned with many other state and national initiatives. The listing below is illustrative rather than exhaustive.

The Statewide Implementation Program, directed by a PALMS PI, has received \$4.8 million to disseminate and implement in Massachusetts field-tested exemplary curricula that support the PALMS vision and Frameworks. PALMS assisted with the development of Boston's Urban Systemic Initiative, whose plan for professional development follows the PALMS model. PALMS provided some funding to facilitate start-up activities for the city of Cambridge's NSF grant.

PALMS served as a forerunner of the Department's Mass Ed On-Line Project. Most importantly, PALMS is in the vanguard of the Massachusetts Department of Education school reform agenda, which will be funded from state and federal sources. Massachusetts has received \$1.8 million of Goals 2000 funding, and expects to receive another \$7 million next year. The Department expects additional allocation of over \$650 million of state funds to support school reform initiatives over the next five years. Funding of this magnitude, for this purpose, will allow PALMS to become an integral part of the Massachusetts education landscape for the foreseeable future.

VII. Evaluation

The Program Evaluation and Research Group at Lesley College, which has extensive experience in evaluation of NSF projects, serves as the independent evaluator for PALMS. The PALMS evaluation design combines a wide range of methods to provide both formative and summative evaluation through the creation of a detailed portrait of program activities and structures, while attempting to highlight issues and components that will affect systemic change in science and mathematics. Methods used include observation of key activities; interviews with participants at all levels; questionnaires administered to key groups; and collection of documents such as minutes, agendas, planning documents, district action plans, and other documents related to PALMS activities and the work of partners.

The evaluators provide interim reports on the progress of PALMS several times a year, and meet regularly with the PIs to share feedback and adjust the evaluation design to account for evolving components and priorities of the initiative. The formative feedback has been very useful to the PALMS leadership. Specific

actions taken in recent months in response to such feedback include actions to strengthen and clarify the role of the Steering Committee, actions to strengthen communication within the leadership team, and actions to increase outreach to parents and involvement of parents in the initiative.

In addition, the evaluation team helps guide PALMS in designing its own internal documentation activities, for example by providing input into the Indicators of Success that form part of the Strategic Plan, and helping to create a district self-assessment tool which will be used by districts with assistance from the Regional Providers to document progress toward systemic improvement in mathematics and science learning.

VIII. Conclusion

In its first two years, PALMS has established a framework and direction for systemic improvement in K-12 mathematics and science education, pre-K through adult. PALMS has established standards for content, pedagogy, and equity by producing the first Curriculum Frameworks for the state; it has created a core group of dedicated and skillful change agents among educators at all levels; it has demonstrated the effectiveness of a professional development model that is itself constructivist, building on teachers' prior knowledge and experience; it has demonstrated the power of multisector leadership change teams to plan and implement change at the district level; it has sparked self-examination and exploratory changes in pre-service education; it has begun to disseminate information about and access to exemplary curricula and professional development programs that support the Frameworks; and it has established an electronic network connecting all schools districts in the state. PALMS has established itself as a lead initiative for education reform in Massachusetts.

PALMS has matured and evolved in the midst of a growing state mandate for education reform. The current state environment is rich with opportunity and challenge. On the district level, PALMS must ensure quality control as it scales up its efforts to reach new districts through Regional Providers. On the state level, it must continue to integrate PALMS efforts with changes called for in the Education Reform Act of 1993 and Goals 2000. PALMS must see that the Frameworks are implemented--that is, widely used to guide curriculum and learning. Critical to this implementation is ensuring that assessments currently under development will reflect the PALMS principles and approach. Professional development must extend to providing the specific content knowledge needed to support implementation of the Frameworks. Change in teacher preparation is just beginning, and needs to be pushed forward. Extending the focus of PALMS to include technical literacy and workforce preparation will require deeper involvement of the business community. Finally, PALMS needs to pilot and share strategies to ensure equity of opportunity and rising achievement for all students.

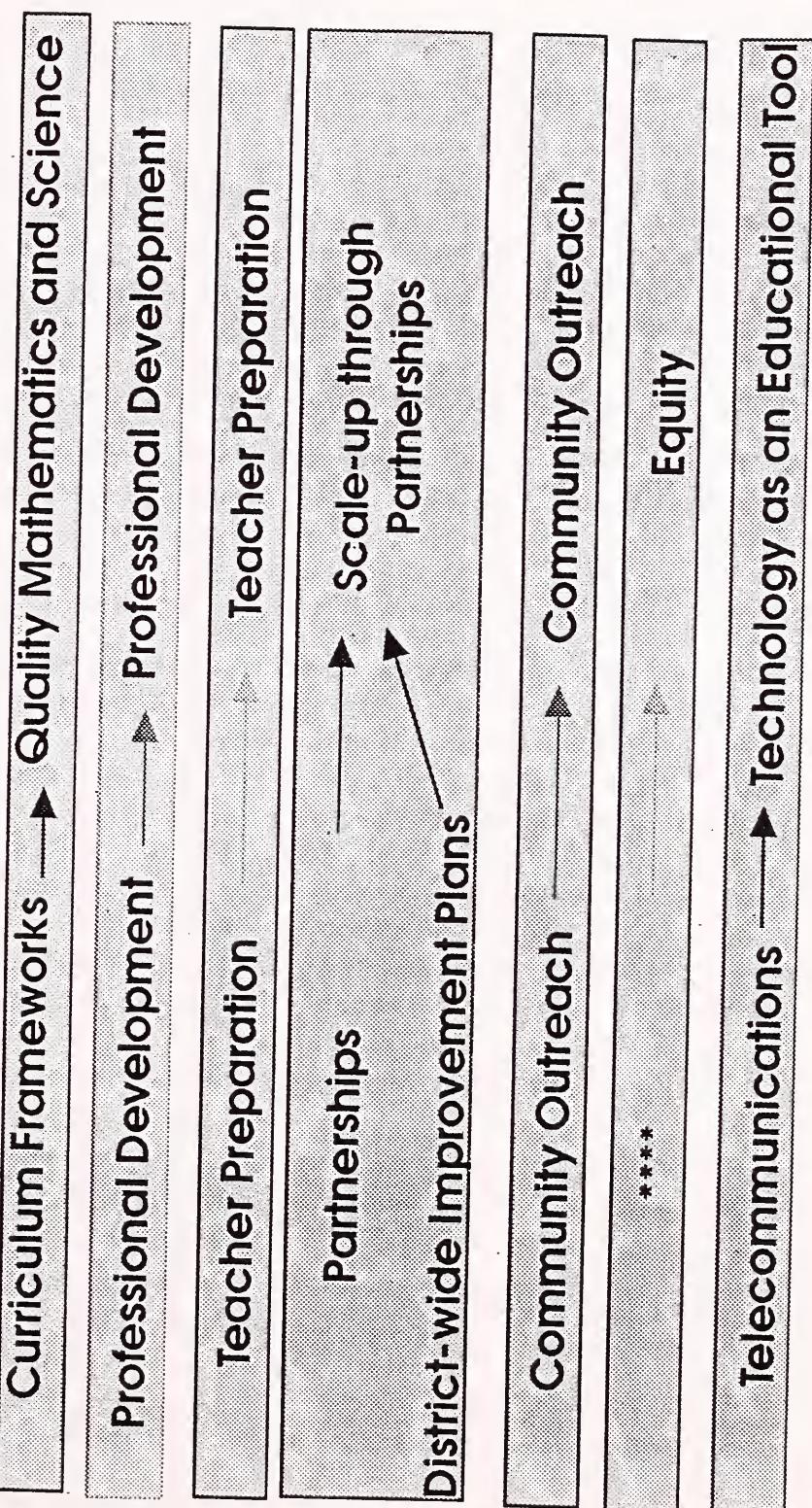
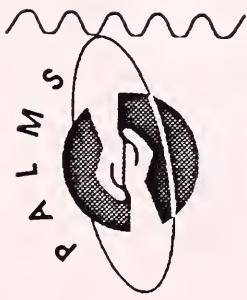
These challenges are substantial, but over the past two and a half years PALMS, with guidance from NSF and critical feedback from its own evaluators, has laid the groundwork necessary to meet them. We approach the second half of the work set out in our cooperative agreement with confidence and excitement.

Appendix 1

Then and Now

1992 Focal Areas

1994 Focal Areas



Appendix 2

PALMS Principles -- An integral part of the Curriculum Frameworks

Chapter 2: Learning, Teaching, and Assessing Mathematics and Science

The content standards set forth in Chapter 3 of this framework present a vision of what every child educated in the Massachusetts public schools will know and be able to do. All students are expected to achieve the standards, and all districts, schools, teachers, and community members are expected to provide the support, resources, and time that each child needs to do his or her best.

The time and pathways that students and teachers use to reach the goals set forth in the standards will vary according to the needs of each classroom. However, all pathways share an underlying set of principles based on knowledge about the process of learning and the strategies of teaching and assessment.

This chapter presents a set of key principles (drawn largely from the PALMS principles) to describe the characteristics of learners and the nature of teaching and assessment. These principles are supported by findings from research in cognitive science, and mathematics and science learning research. Implemented as a whole, these principles create a learning environment and community in which all students can attain mathematical and scientific understanding. While the principles highlight and discuss separate ideas, the components of learning cannot be isolated. Learning is a complex process that takes place in a complex environment, which arises out of an interplay among principles.

Principles for Learning, Teaching and Assessment

- All children can learn.
- Learners construct their own meanings.
- Learning is a life-long process that begins and continues in the home and extends to school and community settings.
- Learners learn best in an environment which acknowledges, respects, and accommodates each learner's background, learning style, and gender.
- Mathematics and science instruction should emphasize the quality of understanding rather than the quantity of information presented.
- Students learn science and mathematics by engaging in authentic tasks of inquiry, reasoning and problem-solving that reflect real-world scientific and mathematical practice.
- Hands-on experiences deepen understanding of abstract concepts by encouraging the practice of process skills and communication and allowing for reflective thinking.
- Learners need the social and organizational skills developed by working in groups. Working in groups helps learners make sense of science and mathematics through communication. Learners benefit from social, organizational, self-evaluative, and small-group settings.
- Technology should be used as a tool for learning mathematics and science.
- Mathematics and science instruction should emphasize connections within and across disciplines.
- Assessment should be used as a tool to improve instruction and enhance student learning.

APPENDIX 3

Grade 4 MEAP Results - Proficiency Level Scores 1992-94

Level 1 and Below Level 2 and Above Level 3 and Above

Boston	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change
Math	72.5%	68.5%	-4	27.5%	31.5%	+4	5.3%	4.6%	-0.7
Science	77.2%	69.6%	-7.6	22.8%	30.4%	+7.6	5.3%	4.7%	-0.6

Level 1 and Below Level 2 and Above Level 3 and Above

Other PALMS Districts	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change
Math	51.4%	41.8%	-9.6	48.6%	58.1%	+9.5	13.8%	14.6%	+0.8
Science	52.7%	39.6%	-13.1	47.5%	60.4%	+12.9	16.1%	16.9%	+0.8

Level 1 and Below Level 2 and Above Level 3 and Above

Non-PALMS Districts	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change
Math	41.8%	35.8%	-6	58.2%	64.2%	+6	18.3%	18%	-0.3
Science	43.6%	33%	-10.6	56.3%	66.9%	+10.6	20.6%	20.1%	-0.5

Level 1 and Below Level 2 and Above Level 3 and Above

Boston PALMS Schools	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change
Math	80.1%	74.9%	-5.2	19.9%	25.1%	+5.2	3.0%	3.2%	+0.2
Science	86.1%	71.4%	-14.7	14.0%	28.6%	+14.6	2.3%	1.9%	-0.4

Level 1 and Below Level 2 and Above Level 3 and Above

Boston Non-PALMS Schools	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change	1992	1994	Percentage Point Change
Math	71.7%	67.8%	-3.9	28.4%	32.2%	+3.8	5.6%	4.7%	-0.9
Science	76.2%	69.4%	-6.8	23.7%	30.6%	+6.9	5.6%	5.0%	-0.6

Below level 1--no answer.

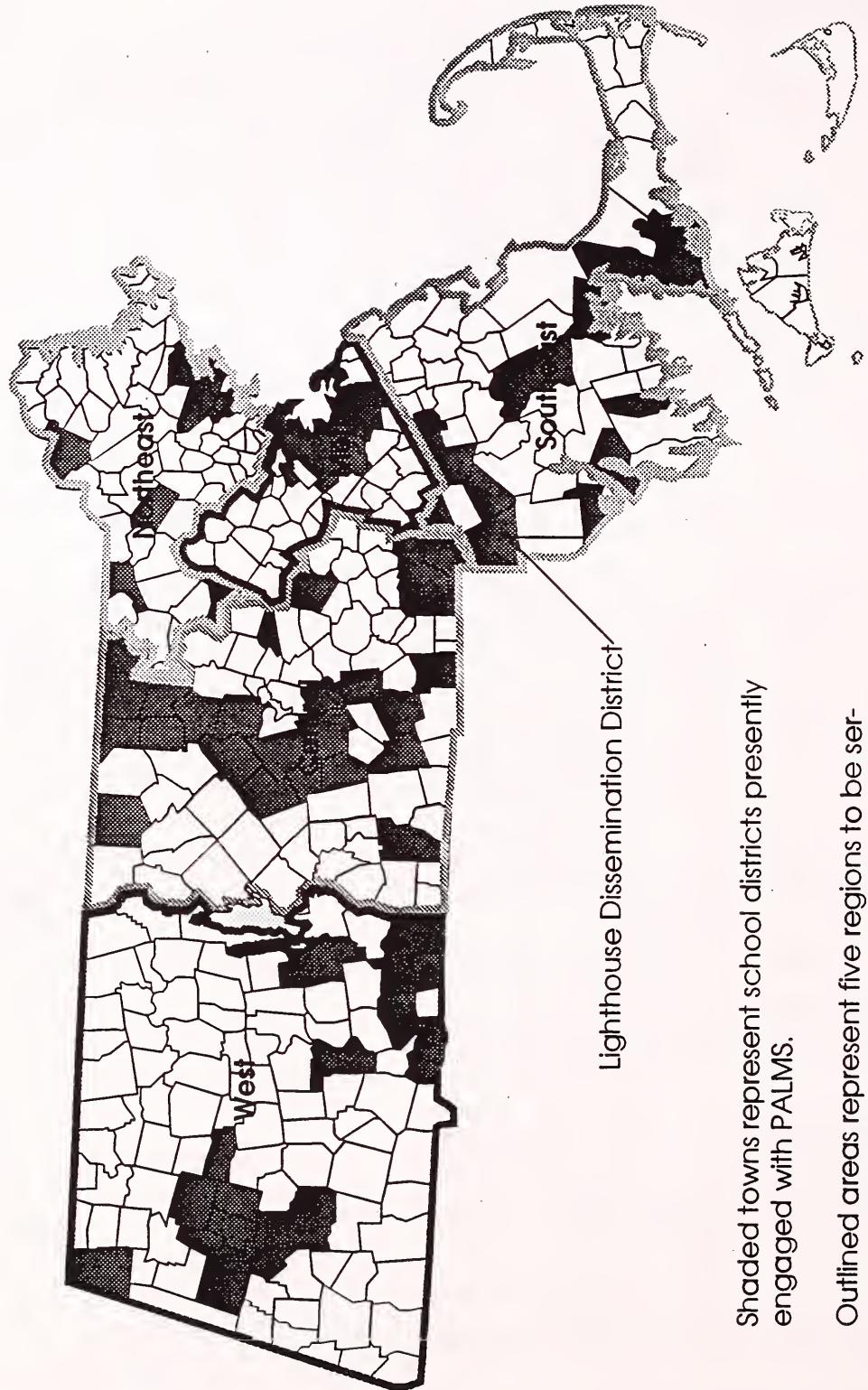
Level 1—demonstrates inadequate knowledge of fundamentals.

Level 2—adequate knowledge of fundamentals; no higher-order thinking demonstrated.

Level 3—demonstrates higher-order thinking, problem-solving and communication skills.

Level 4—exemplary responses.

Appendix 4



Coordination of Initiatives



District Level

Adoption and adaption of Instructional materials

PALMS Specialists/Trainers work with teachers to select instructional materials and provide consultation on implementation.

Alignment of curricula, instructional materials, and assessments with state content and student performance standards.

School Level

School Councils

In PALMS Schools:
PALMS Sites begin with target schools; PALMS Specialists work with teachers in these schools to introduce and implement constructivist teaching strategies.

Development, implementation and evaluation of state assessment aligned with and used for measuring state content standards.

Opportunities for all students to reach standards.

In other schools:
Conduct awareness sessions.

Improvement plans addressing how to meet content, student performance, and voluntary opportunity-to-learn standards.

Coordination of Initiatives

